SUPPORTING INDUSTRIES

Project Fact Sheet

A Hybrid Integrated Model for Gas Metal Arc Welding

Benefits

Following are the estimated benefits that the technology will provide to the fabrication sector in North America:

- Rapid deployment of advanced materials planned for use in chemical, forest, mining and steel industries by making them weldable, and eliminating development of advanced materials that do not satisfy the weldability requirements
- Reduction in steel consumables wastage related to fabrication of welded structures by 10% which translates to 0.1 billion pounds of steel rework
- Welding energy savings throughout the fabrication sector of 569 billion Btu/year
- Reduction of 0.02 billion Btu/industry/year in energy wastage due to trial and error

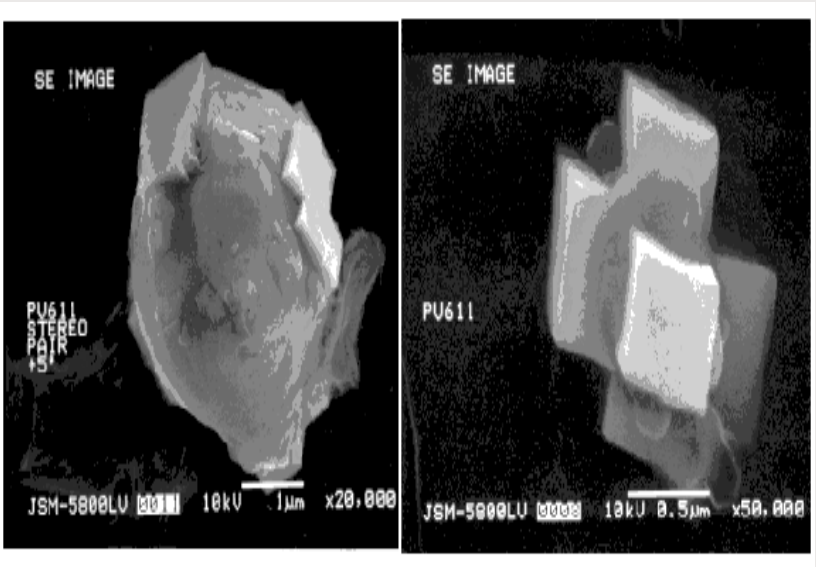
Applications

The welding technology will be applied to gas metal arc welding operations throughout the fabrication sector.

A gas metal arc welding (GMAW) model that integrates individual physical processes of GMAW to improve weld quality, microstructure, and properties

Traditionally, the weld process modeling has focused on individual physical processes including heat transfer, fluid flow; arc- plasma, gas- metal and slag-metal interactions; solidification; and solid state transformations, and their effects on welding characteristics, weld quality, productivity, microstructure and weld properties. This project takes an approach to completely optimize the welding process, the process parameters and the welding consumable sections. The approach is of developing a hybrid integrated model for GMAW that will combine both the fundamental approaches based on physical science and the artificial neural networks based on industrial experimental data. The model will have direct immediate benefit in optimizing the welding processes using both the solid and the cored wire Fe-C-Mn-Si electrodes. The technology will replace expensive trial and error experimentation to develop weld process and consumables for advanced materials.

Weld Inclusions



Typical inclusions that form in weld, which have major influence on microstructure and properties.

Project Description

Goal: The project goal is to describe operational characteristics, weld thermal cycles, weld pool geometry, microstructure and property for GMAW process for low alloy steel solid and cored wire electrodes - achieved by developing sub-process models that will deal with each phenomenon and its interactions. The objective is to develop a tool that can:

- Provide a framework for modeling other welding processes and consumables.
- Integrate and streamline the development of new welding processes and consumables.
- Optimize the welding process for productivity and quality.

A potential project limitation may be the uncertainty of accounting for all interactions that may occur between different physical processes due to parameters not controlled during welding operation. However, the technology could be retrofitted with the current realtime data-analysis tools by using additional equipment, or modified welding power sources, that can do an automatic change of operational characteristics to achieve the desired properties.

Progress and Milestones

- Project start date, October 2001.
- Project end date date, October 2004.
- Year 1: Complete the computational tool for operational characteristics based on process and consumable variables.
- Year 2: Verify and refine model for operational characteristics. Complete weld pool, thermal cycle, and microstructure models.
- Year 3: Model microstructure-mechanical properties correlations. Complete integration of all modules in an integrated computational tool.

Commercialization Plans

To be determined.

Project Partners

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